1. Scope

1.1 This procedure covers inspection of grind temper by surface temper etch used to monitor grinding of carburized gears.

2. Referenced Documents

2.1 ANSI/AGMA 2007-B92 Surface Temper Etch Inspection After Grinding.

2.2 GEARTECH Specifications:

CK8507 QP8507 Inspection of grind temper

3. Terminology

3.1 Grind temper- Overheating during grinding causing discoloration and microstructural change due to tempering, annealing, or rehardening. Sometimes called grind burn.

3.2 Standardized test specimen- A specimen with known temper indications used to verify effectiveness of the surface temper etch procedure.

3.3 Surface temper class- The classification of degree of tempering and area affected on functional and nonfunctional surfaces in accordance with ANSI/AGMA 2007-B92.

3.4 Surface temper etch- The process of subjecting the surface of a metal component to chemical attack to reveal microstructural change. Sometimes called nital etch.

4. Significance and Use

4.1 Application- Surface temper etch inspection is used to detect areas with grind temper. Overheated areas can be softened, beneficial compressive residual stresses may be reduced, and detrimental tensile residual stresses may be imparted. Fatigue life can be significantly shortened by grind temper. Severe grind temper may cause cracks.

4.2 Process control- Risk of grind temper varies with grinding parameters such as grinding wheel type, wheel dressing, feed, speed, and coolant, and workpiece microstructure such as retained austenite and hardness. Surface temper etch inspection is useful for monitoring process control of grinding.

5. Apparatus

5.1 Process equipment and materials- Process equipment and materials shall be in accordance with ANSI/AGMA 2007-B92 for type 2 immersion baths.

5.2 Standardized test specimen- The standardized test specimen shall be a gear or sector of gear teeth with known grind temper indications.

6. Test specimens

6.1 Gears- Surface temper etch inspection shall be performed on gears after all grinding is completed.

7. Procedure

7.1 Specification conformance- The test procedure and test apparatus shall conform to ANSI/AGMA 2007-B92 for type 2 immersion baths.

7.2 Temperature- Temperature in the immediate area of the immersion baths shall be 20°C ± 2°C.

7.3 Verification of test procedure- The effectiveness of the surface temper etch procedure shall be verified before any inspection. At each verification, the standardized test specimen shall be inspected with the same procedure used to inspect production gears.

7.4 Calibration of test procedure- If verification of the test procedure does not reproduce the known indications on the standardized test specimen, the test procedure shall be adjusted and the verification shall be repeated until the known indications are reproduced.

7.5 Areas inspected- Unless otherwise specified on the engineering drawing for the gear, 100% of all ground surfaces shall be inspected.

7.6 Swabbing technique- Unless otherwise specified on the engineering drawing for the gear, the swabbing technique shall not be used.

7.7 Bake- After surface temper etch inspection is complete, the gear shall be baked to avoid hydrogen embrittlement. Maximum temperature during baking shall be 14°C (25°F) below the final heat treat tempering temperature used for the gear.

8. Interpretation of results

8.1 Surface temper class- The degree of tempering and area affected on all functional and all nonfunctional surfaces shall be assessed and classified in accordance with ANSI/AGMA 2007-B92.

9. Acceptance criteria

9.1 Acceptable limit- Unless otherwise specified on the engineering drawing for the gear, the surface temper class shall not exceed AGMA 2007 FA/NB2.

10. Report

10.1 The report shall include the following:

10.1.1 Surface temper class,

10.1.2 Record of bath solutions and immersion times in accordance with Table 2 of ANSI/AGMA 2007-B92,

10.1.3 Record of temperature and time for bake,

10.1.4 Record of verifications, and

10.1.5 Record of calibrations.